EVERY STUDENT IS A SCIENTIST: USING TECHNOLOGY TO FOSTER INCLUSIVE LEARNING

ABSTRACT

Since February 2001, Brookfield Zoo has provided on-site training workshops for nearly 200 special education teachers from Chicago Public Schools (CPS). Through these sessions, zoo staff became aware that the teachers had two significant needs. They were looking for engaging content for students with disabilities, and they were challenged to find more effective ways of including students with disabilities in learning activities with students who are not disabled. **Every Student is a Scientist: Using Technology to Foster Inclusive Learning** is being developed to address those needs.

The program builds upon Brookfield Zoo's award-winning Access Program for people with disabilities and the zoo's expertise in developing technology-based curricula. The zoo has a long history of working with teams of teachers to develop school programs. The zoo's 13 current curricula provide classroom lessons before a zoo visit, field trip activities with a zoo educator, and classroom activities for after the field trip. This approach, which annually serves tens of thousands of students, will be applied to "re-purposing" 4 of the zoo's curricula for use with hand-held computer devices, improving accessibility and learning gains of disabled students. This will involve adapting and manipulating the curricula (printed pages, still images, and video images) to an interactive computer medium.

Every Student is a Scientist has 4 primary goals:

1. To use wireless technology to make inquiry-based learning opportunities more accessible to students with physical, visual, and auditory disabilities.
This will involve 3,600 CPS students with disabilities working in teams with classmates to develop, test, and finalize the re-purposing of 4 zoo curriculum units. Teams of teachers will be involved in developing content, ensuring that hand-held devices effectively serve disabled students, and evaluating the process from formative assessment through summative evaluation. This also will serve as a pioneering process that could become a model for other museums to use wireless technology to serve students and visitors with disabilities.

2. To support the Illinois State Board of Education's Least Restrictive Environment Policy. This requires that, as appropriate, students with disabilities are educated with students who are not disabled.
The "assistive technology" that will be employed in **Every Student is a Scientist** will greatly enhance the ability of CPS teachers to address this policy. The curricula will be re-purposed to serve the needs of students with disabilities, allow them to learn alongside their classmates. This Least Restrictive Environment policy is also mandated by the individuals with Disabilities Education Act, and **Every Student is a Scientist** could serve as a model for museum-school partnerships to help educators follow such policies.

3. To create a model of re-purposing education program content for use with wireless technology that can be used at Brookfield Zoo and at other informal science institutions.
The program will involve re-purposing one Pilot Curriculum through working with CPS students and teachers, consultants, and evaluators. This process will then be applied to 3 additional zoo curricula, and will result in 4 new programs to offer specifically to class with disabled students. The zoo estimates that each year, the new programs could serve about 8,000 students with disabilities and their classmates.

4. To assess the effectiveness of this model and disseminate the results to the informal learning community. Many museums have education programs for school groups, but few have programs that are technology-based, and even fewer have technology-based curricula for disabled students. Given that more than six million children nationwide receive special education, there is a great need for this type of programming. By documenting the entire process, the zoo hopes to provide a model for other institutions to use in developing programs for disabled students.

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SUMMARY

Brookfield Zoo and Chicago Public Schools are partnering on a project to develop wireless technology-based educational opportunities at the zoo for students with disabilities. Every Student is a Scientist: Using Technology to Foster Inclusive Learning builds upon Brookfield Zoo's award-winning Access Program for people with disabilities and its expertise in developing technology-based curricula. Every Student is a Scientist will focus on creating and testing a process for "re-purposing" zoo/museum curricula for use with hand-held digital devices that will improve accessibility and learning gains. Specifically, the project will re-purpose four of Brookfield Zoo's existing curriculum units. This will involve adapting and manipulating the curriculum units (printed pages, still images, and video images) to an interactive computer medium. The new technology-enhanced programs will address the needs of students with disabilities, allowing them to learn alongside classmates who are not disabled. The re-purposing process will be shared broadly with other informal education institutions, helping zoos and other museums to develop innovative approaches to effectively reaching students and other visitors with disabilities.

NATIONAL IMPACT AND ADAPTABILITY

Zoos can provide truly memorable and inspirational learning experiences. In a 1998 evaluation of the National Science Foundation's Informal Science Education program, researchers found that nearly 93% of people with science careers ranked a visit to a zoo, aquarium, or planetarium as their most memorable informal science education experience from childhood. This was more than any other activity such as visiting a museum, having a science-related hobby, reading science books, watching science TV shows, or even participating in science fairs (COSMOS Corporation. March 1998).

Zoos also are uniquely positioned to provide authentic science education experiences that address state and national science education standards. Education has been a primary goal of the Chicago Zoological Society since the opening of Brookfield Zoo 68 years ago. The ways in which this goal is realized have changed over time, but the importance of enhancing people's appreciation of the earth's biological heritage has remained fundamental in the Zoo's operations. Meaningful and effective education programs are essential to meeting the Chicago Zoological Society's mission of helping people develop more sustainable and harmonious relationships with nature. In 2001, Brookfield Zoo again welcomed more than 2 million visitors, including some 215,000 school group participants from throughout the Chicago community, Illinois, and surrounding states. Zoo staff have worked with teams of teachers to develop 13 curriculum units, and over the past three years, staff have worked with teachers to develop technology-based programs.

Brookfield Zoo has had a formal Access Program for people with disabilities since 1982. In 1999, Brookfield Zoo's Access Program received the American Association of Museums ' Accessibility Award. In partnership with the National Organization on Disability, this award is given annually to one museum that has made an outstanding contribution in improving accessibility to people with disabilities. Brookfield Zoo was the first zoo to be recognized with this honor. The zoo also has been recognized by the Center for Universal Design at the North Carolina State University as one of 30 organizations worldwide that exceed accessibility code requirements. The zoo was highlighted for its universal design in exhibits, interpretive graphics, and visitor amenities.

The Chicago public school (CPS) system, the third largest in the nation, is comprised of over 550 schools, 26,000 teachers, and more than 400,000 students. Eighty-five percent of the students in CPS come from low-income families, and 14% have disabilities. The mission of the Chicago Public Schools Office of Specialized Services (CPSOSS) is to ensure that every student has equal access to all programs and activities in the CPS; improve the achievement of students who are gifted, disabled, and have special needs through effective and innovative service delivery models that meet the needs of the individual learner; promote high standards and expectations; prepare students for graduation and employment and capitalize on the resources of families, teachers, and community.

1.Technology and Special Education

CPS, like many school systems across the country, has a strong focus on inclusion, which is a commitment to educating disabled students, as appropriate, with students who are not disabled. It involves bringing support services to the student (rather than moving the student to the services) and requires that the student be able to work at his/her own pace. When appropriately used, technology has great potential to assist in this process. Research shows that, with the right tools and with teachers trained to use them, students with disabilities can become integral and vital participants in the classroom, and they can master basic skills and challenging curricula. Technology, ranging from the simplest "low-tech" tools to more complex "high-tech" devices, can help meet a variety of the educational needs of students with disabilities. With six million children nationwide receiving special education, this type of programming is greatly needed (Consortium for Citizens with Disabilities).

The effective use of technology-based accommodations can also improve the learning gains of non-disabled students. Janice Majewski, Smithsonian Institution Accessibility Program Coordinator writes, "Experience has repeatedly shown that accommodations designed to serve disabled persons generally improve the quality of programs for the broader public audience. In short, museums cannot afford not to make their programs accessible to all visitors."(The Arts and 504 Handbook,1992).

However, the effective integration of technology into the learning process is often difficult. A 1998 report on school technology in the Chicago Public schools reported that 96% of teachers agree that "the use of computer technology has a positive impact on student achievement" and that "technology must be woven into everything they do" but "effective integration is reportedly the most difficult task associated with technology". In addition, only 46% of the teachers report they "have received enough training to feel comfortable incorporating technology into the classroom curriculum." (The Chicago Panel on School Policy, 1998).

Informal learning institutions like zoos and museums can provide a wealth of engaging content and staff expertise to help train teachers and integrate technology into classroom teaching. Brookfield Zoo has a long history of providing professional development training for educators, including helping them incorporate technology-based programs into their teaching. For example, Brookfield Zoo was one of the first participants in the Illinois State Board of Education's *Museum in the Classroom* program, which provided opportunities for museum staff to train teachers and students to develop Web sites and Web-based projects. Each year, the zoo provides formal school programs including teacher workshops that reach more than 1,200 teachers, technology-based programs for older school children, and 13 curriculum units specially developed by Zoo staff working with teams of teachers. These units address the State of Illinois Goals for Learning and the National Science Standards, and contribute to the education of tens of thousands of students each year.

2. Technology-Based Education Model for Museums

Through Every Student is a Scientist, Brookfield Zoo and CPS will develop and test a model for integrating technology into four existing curricula that center around a zoo visit. The model includes the active participation of accessibility experts and teachers from CPS, science educators and evaluators from the Illinois Institute of Technology (IIT), and 120 inclusive and specialized CPS classes of students along with their teachers. The curricula selected for re-purposing already include strong inquiry-based classroom and zoo-visit components, however their accessibility and effectiveness will be greatly improved through the use of hand-held digital devices that make observations and data collection easier for all students. Through utilizing wireless connectivity, students will have unprecedented access to a variety of learning resources during their zoo visit. Every Student is a Scientist will test the effectiveness of the re-purposed curricula used in conjunction with the devices compared to the original curricula. These results, along with a re-purposing source book documenting our experience, will be disseminated nationally through a variety of media to informal science educators and school-based access programs.

Many museums (and some zoos) have begun to make information available via hand-held devices, but most of these projects have focused on general visitors rather than school groups, who need more structured experiences and have a greater need for specific information. For example, the Smithsonian used Apple Newton devices to offer additional media files as

interpretation of its traveling "America's Smithsonian" exhibit in 1997 (CNN Interactive). A number of art museums, including New York's Museum of Modern Art (MoMA) and the Dayton Art Institute have used devices to deliver MP3 audio tours. The Berkeley Art Museum offered users Apple Newtons loaded with audio and text files as guides to 15 exhibits. The Whitney Museum had similar offerings for its exhibit in 1999, "The American Century" (CIMI Consortium).

Most of these projects were limited by the capacity of the devices themselves because files were installed locally, rather than accessed from a central server, resulting in limited offerings. The American Museum of Moving Images is currently prototyping an eDocent system that is much closer to **Every Student is a Scientist**. The eDocent program offers information specific to four exhibits, which is downloaded to the museum patron's Web tablet device as they approach the exhibit. Users can also bookmark and e-mail information to their home computer.

Even closer to the zoo's vision, the San Francisco Museum of Modern Art and the Exploratorium are currently prototyping programs using Personal Digital Assistants (PDAs) to allow users to access information specific to the exhibits in their proximity via wireless networks. With more than 28 million PDAs sold during the past 5 years, these devices are becoming increasingly more popular with the general public, and are likely to be used even more extensively by museums. Three other museums that currently offer programs via PDAs include the Experience Music project in Seattle, which offers 80,000 artifacts to exhibit goers via a Palm PDA device; the Cincinnati Art Museum, which is offering surveys via PDAs; and Chicago's Field Museum, which provides some tours viaPDA (Museum News, 2001).

DESIGN

During the past year, Brookfield Zoo has provided on-site training workshops for almost 200 special education teachers from CPS. Through these sessions, staff became aware that the teachers were looking for engaging content for educating students with disabilities and for more effectively including them in learning activities with students who are not disabled. **Every Student is a Scientist** is being developed to address those needs, and will follow the teacher-based approaches for curriculum development that Brookfield Zoo has used to develop its 13 current curriculum units.

1. Audience

Illinois statewide performance results for 2001 show that only 65% of 4th graders, 72% of 7th graders, and only 50% of 11th-grade students meet or exceed the State's standards for science, leaving many children behind in their basic knowledge and applications of science in their daily lives (Chicago Tribune, 2001). So, improving science knowledge and skills is a priority throughout the region. this is an even greater challenge for students with disabilities

According to the U.S. Department of Education, during the 1998-99 school year, 124,982 Illinois students (ages 12-21) were considered disabled, approximately 14% of the student population. CPSOSS serves about 55,000 students annually.

To effectively re-purpose the four curriculum units, zoo and CPS staff will develop and test the programs with approximately 3,600 students from 6th-12th grades. To test the new programs, **Every Student is a Scientist** will involve classes that include students with visual, auditory, and physical disabilities. Once the process is completed, these modified curricula, along with the relevant hand-held devices, will be available to any visiting classroom that includes students with disabilities. Based on Illinois averages and average participation in current zoo curriculum programs, each year the program will serve approximately 8,000 students with disabilities and their classmates. In addition, many of the capabilities of the devices will be attractive to non-student visitors with disabilities, so the zoo will make the devices available on a first-come, first-served basis on weekends and during the summer months.

2. Goals and Objectives

Goal 1: To use wireless technology to make inquiry-based learning opportunities more accessible to students with physical, visual, and auditory disabilities.

Objectives:

- to improve the accessibility of four existing curriculum units by re-purposing select content for use with wireless hand-held devices.
- to install a wireless system in the exhibits featured in the four curriculum units.

- to involve 120 CPS middle and high school classes in testing Every Student is a Scientist. .to offer wireless assistive devices at no cost to students with disabilities visiting the zoo.

Goal 2: To support the Illinois State Board of Education' s Least Restrictive Environment Policy. This requires that, as

appropriate, students with disabilities are educated with students who are not disabled. Objective:

Objective:

- to develop, test, and disseminate pedagogical approaches that use wireless technology to support inclusion.

Goal 3: To create a model of re-purposing education program content (curriculum units, interpretive materials) for use with wireless technology that can be used at Brookfield Zoo and at other informal science institutions generally such as zoos, aquariums, museums, and botanical gardens.

Objectives:

- to work with a team of CPS educators with expertise in special education, inclusion, and assistive technology
- to use a three-phase development process (alpha test, beta test, final version) to experiment with the different capabilities available through wireless technology

Goal 4: To assess the effectiveness of this model and disseminate the results to the informal learning community.

Objectives:

- to work with UT to implement an evaluation program that documents the re-purposing project and compares the effectiveness of the four curricula with and without the wireless components.
- to create an on-line and printed guide to re-purposing curricula for use with this technology.
- to present results at national conferences serving the zoo/museum and accessibility communities.

3. Technology Uses for People with Disabilities

Wireless hand-held devices offer a variety of options in terms of assisting students with disabilities to learn at the zoo. Listed below are specific accommodations in terms of type of impairments (TechIDEAs That Work).

Visual Impairments (VI): Specific challenges could include reading directions, viewing animals in an exhibit, and difficulty identifying observed animal behaviors that happen quickly, and seeing animals at a distance.

- Directions and animal information could be accessed in an audio format or in enlarged print.
- If the student has limited visual capabilities, the specific animal behaviors the class is to observe (ethogram) could be viewed in a video format on the handheld device.
- A learning model of having students work in teams would allow the VI student to participate at or near the same level as the entire class. As a team member, the student may not have the sole responsibility of identifying behaviors but may play an equally important role of recording data on the wireless device.

Hearing Impairments (HI): Specific challenges involve all aspects of verbal communication, such as verbal directions and discussions about animal behaviors.

- HI individuals face relatively minor barriers to computer use. All directions would be text-based, and the specific animal behaviors the class is to observe (ethogram) could be viewed in a video format on the handheld device.
- Students would be able to take notes using devices with word prediction capabilities, and they could send the notes back to the classroom via email.
- A learning model of having students work in teams would allow the HI student to participate at or near the same level as the entire class. As a team member, the student may track the time of observations.

Physically Impaired (PI): Specific challenges could include difficulty writing, recording data, and participating in outdoor activities.

- Wireless Devices that offer barrier free access could enhance accessibility for individuals with mobility impairments. The devices would have word prediction capabilities to assist with notetaking. Audio and video formats would assist students while they are at an exhibit.

- Some of the devices would be outfitted with larger buttons or other adaptations needed (wheelchair mount, larger or properly shaped stylus, or switches).

4. Curriculum Units to be Re-Purposed

Four existing programs will be re-purposed to work with wireless technology for students with disabilities. Three of these curricula have been successfully tested with teachers and students and are in use in classrooms throughout Illinois. The Africa curriculum is currently in the final stage of development.

a. Africa: The Land, the People and the Animals

This program demonstrates and explores the interrelationships between the geography, people, and animals of three African ecosystems: rain forest, savannah, and desert. During a field trip, students will focus on three different cultures and learn how they interact with their environment.

Learning Goals:

- to understand the physical and political boundaries that have shaped and now define the continent of Africa-
- to develop an appreciation for the diversity of cultures, animals, and geography of Africa' s deserts, savannahs, and rain forests.
- to learn how culture, geography, and animals influence each other within these ecosystems.

b. Ecosystems on the Edge

This unit explores the characteristics of ecosystems, the importance of the interrelationships within a habitat, and how these relate to the formation of national parks and other protected nature reserves. The self -guided in-zoo portion helps students discover various ecosystems.

Learning Goals:

- to develop a working definition of ecosystems, including living and nonliving components and their interrelationships, as well as related concepts such as fragmentation, edge, edge effects, and biodiversity, which form the basis for higher-level cognitive skills addressed below.
- to analyze biodiversity, interrelationships, and edge effects in study sites near the school, through observation and measurement.
- to apply the concepts of ecosystem fragmentation, edge effects, and interrelationships to the design of a nature reserve
- to design and evaluate a nature reserve for different animal species.

c. Endangered! Primate Populations

This is a multidisciplinary examination of some of the world's most popular and endangered mammals: primates. At the zoo, students will make detailed observations at *Baboon Island* to learn how scientists study animals.

Learning Goals:

- to describe behavior observation techniques and research materials used in zoos and in the field.
- to identify and observe primate species found in Brookfield Zoo's *Tropic World.*
- to describe basic behaviors exhibited by Brookfield Zoo's baboon population on *Baboon Island.*
- *to identify baboons by age, social ranking, and sex.*
- to allow students to participate in an authentic research experience.

d. ***To Save a Species: Designing an Exhibit***

This upper elementary unit is one of three planned curricula that immerse students in the work of conserving endangered species. Using real data and the zoo's extensive experience breeding endangered species, students work in teams to design appropriate exhibits for a breeding colony of Humboldt penguins.

Learning Goals:

- to introduce students to the field of conservation biology through zoo exhibit design- .to make students aware of the process involved in designing zoo exhibits.
- to enable students to apply their knowledge by acting in real-world, team-based design groups.

To follow is an example of how one of these curriculum units would be re-purposed:

Endangered! Primate Populations

This program uses the appeal of studying primate behavior to give students practical experience with the scientific method and helps students develop their skills in making accurate observations. Students create hypotheses relating to baboon behavior and test their "predictions" by observing baboons during their zoo visit. This curriculum unit has been successfully tested by teachers and more than 12,500 students during the last six years (see enclosed curriculum packet). In the current

program, students use printed forms to collect data while observing baboons living in a large, outdoor rock structure. The size of the exhibit, its 360-degree design, and the speed of the baboon activities can make observations difficult for students with physical or visual impairments. Tore-purpose *Endangered! Primate Populations,* staff will experiment with different approaches to improving the learning experience for all students. One possible approach is described below:

1. The current **pre-visit classroom segment** of the program involves introducing information about baboons and behavioral observation techniques. The re-purposed unit will involve students using the zoo's Web site to access fact sheets and videos demonstrating specific baboon behavior, allowing students to use the videos to develop their observation skills.

2. The **zoo visit** will begin with demonstration activities for students to learn how to use the hand-held devices. Students will work in teams of three: an observer, a timer, and a recorder. Each team will be given one hand-held device to use. The student acting as the recorder will use the device and will type, press, or click to record data using custom designed, on-line data entry forms. The whole team will use the device to access animal information, review video segments illustrating different behaviors, listen to examples of relevant baboon vocalizations, and refer to an electronic ethogram. In addition, they can take notes. The students will conduct observations, collect data, and will be able to send this information directly back to the school via email.

3. Upon **return to the classroom**, teachers will have data files from each observation, allowing them to track students' reasoning as they worked through exercises. The student teams will complete the data analysis, and the teachers will have a readily available portfolio of their work to assess.

5. Project Activities
The curricula re-purposing process at the heart of **Every Student is a Scientist** will involve five phases:
1) experimentation, 2) modification, 3) expansion, 4) implementation and evaluation, and 5) dissemination and broad implementation.

Phase I-Experimentation **(October 2002-May 2003)**
This phase will involve re-purposing of one curriculum unit, *Endangered! Primate Populations.* Working with teams from CPS and wireless software consultants, zoo staff will experiment with how layers of text, images, audio, video, and real-time data collection forms improve the accessibility of this unit. Staff from IIT and the zoo will design a formative evaluation plan for this pilot curriculum unit. In addition, zoo staff and consultants will install a wireless network in exhibits related to the pilot curriculum and will work with teams from CPS to modify hand-held devices for students to use.
The project will test the effectiveness of three types of hand-held devices: Game Boy Advance, Pocket PCs (or equivalent), and wireless web tablets. The three devices vary in costs, durability, weight, ease-of-use, and functionality. Different devices might be appropriate for different audiences. For example, for students who use wheelchairs, a web tablet that could mount to the chair would offer large touch screen "buttons" that would be easy for them to activate. All of the devices offer audio, video, and e-mail capability.
Different versions of the pilot curriculum will be tested by 10 CPS classes (approximately 300 students). The staff from the zoo, CPS, and IIT will observe the students at the zoo and in the classroom, and teacher reactions will be collected. The goal of this phase is to determine what type of content works most effectively with students with visual, hearing, and physical disabilities.

Phase II-Modification **(June-August 2003)**
The pilot curriculum unit will be modified based on the spring testing. Modifications will also be made to the wireless installation in the exhibits and to the devices as indicated by the first testing period.

Phase III-Expansion **(September 2003-August 2004)**
The beta version of the pilot curriculum will be tested with 10 more classes. The information and approaches developed through that process will be applied to re-purposing the three other curriculum units. These units will be alpha tested, modified, beta-tested, and then finalized. Ten classes will be involved in each aspect of the testing, for a total of 600 (20 classrooms with an average of 30 students) students involved in the development of each curriculum unit. The final evaluation plan will be developed. A wireless network will be installed for all exhibits featured in the four curriculum units.

Phase IV-Implementation, Evaluation, and Dissemination **(January-July 2005)**
The four units will be fully available for CPS classes visiting the zoo. IIT staff will collect data for the summative evaluation involving another 40 classrooms, for a total of 900 students involved in re-purposing each of the 4 curricula. The zoo and lIT

will work together to finalize the evaluation of the project. Zoo and CPS staff also will work to identify additional curriculum units to re-purpose after the conclusion of the grant project.

Phase V-Dissemination and Broad Implementation **(August-September 2005)**
Beginning in the 2005-06 school year, the four re-purposed curriculum units will be made available to all school groups visiting the zoo with students with disabilities. It is estimated that this will involve 8,000 students annually. Representatives from Brookfield Zoo and CPS will present the results of the project at national conferences such as those hosted by the American Zoo and Aquarium Association (AZA), American Association of Museums (AAM), Association of Science and Technology Centers (ASTC), and assistive technology conferences. The zoo also will create print and Web site versions of a publication to share information with other zoos and museums as well as with school systems.

MANAGEMENT PLAN
Three teams will be developed to involve representatives from Brookfield Zoo and CPS in each phase of the project. In addition, the evaluation team will involve Brookfield Zoo's Access Advisory Board, which includes representatives from organizations that serve people with disabilities.

Team Definition

Content Team - Re-purpose content and develop the four curriculum units. The team will include:

- Brookfield Zoo: Access Coordinator, Curriculum Developer, Web Program Manager
- CPS: Special Education teacher, General Education teacher with experience with inclusion, Assistant Director of Special Education, and Assistive Technology Facilitators
- Consultant: Wireless software representative

Hardware Team - Install and maintain wireless infrastructure. The team will include:

- Brookfield Zoo: IS Manager, IS Network Manager
- CPS: Assistive Technology Facilitators
- Consultant: Wireless hardware representative, hand-held device manufacturer representative

Evaluation Team - Design assessment of each phase of the project and make suggestions for improvement. The team will include:

- Brookfield Zoo: Access Coordinator, Director of Communication Research
- Brookfield Zoo's Access Advisory Board.
- CPS: Assistive Technology Evaluators
- IIT: Professor and Chair of the Department of Mathematics and Science Education, Senior Lecturer, Department of Mathematics and Science Education

BUDGET AND CONTRIBUTIONS
The budget for the first three years of Every Student is a Scientist is $962,118. This includes zoo and CPS staff time; fees for hardware, software development, and evaluation consultants; buses for students to visit the zoo and participate in developing and testing the re-purposed curriculum units; computer equipment and wiring; and hand-held devices and related equipment. Costs are based on current figures and price quotations from consultants. Brookfield Zoo is requesting support $461,896 from IMLS, including $426,505 for direct costs and $35,391 for indirect costs. These funds would support the Access Coordinator's time on the project, a portion of the consulting fees for developing the curriculum units, bus transportation for developing three curricula with CPS students, travel to IMLS meetings for the partnership, travel to conferences for dissemination, 50% of the costs for creating the wireless network and purchasing computer equipment, printing a re-purposing publication, and costs for licensing wireless software and for computer support and maintenance during the grant period.

Brookfield Zoo will provide $411,491 in support of staff time, fringe benefits, a portion of consultant fees, bus transportation for the testing the Pilot Curriculum with CPS students, 50% of the equipment costs, and 50% of the indirect costs of the project. CPS will provide $88,731 in staff time and 2% of the indirect costs of the project.

PERSONNEL
Every Student is a Scientist will be under the direction of Brookfield Zoo's Curator of Education Keith Winsten, who leads Brookfield Zoo's Education Department. Also assisting with project management will be Robin Dombeck, Assistant Curator of Education, who has worked with Keith and other staff to develop technology-based curriculum units that enhance school field trips to zoo exhibits as well as helping teachers meet state learning goals in their classrooms.

The **Content Team** will be led by the zoo's Access Coordinator Ann Roth. She is currently part-time and will become full-time if this project is funded. The team also will include Josh Mogerman, the zoo's Web Programs Manager, who has been involved in other zoo teams that have developed technology-based curriculum. CPS educators will include Kathy Kinsey, Assistant Director for Citywide Special Education; Kauen Ray, Least Restrictive Environment Teacher/Facilitator, Barbara Hay Oken, a general education teacher with special education experience, and Assistive Technology Facilitators Jackie Phillips and Janine Gruhn.

The **Hardware Team** will be led by Robert Dulski, Brookfield Zoo's Manager of Information Services, and will also include a zoo Network Manager. CPS will be represented on the team by Jackie Phillips and Janine Gruhn, who are both Assistive Technology Facilitators. Consulting wireless hardware and hand-held device specialists will also work with the team.

The Director of the zoo's Communication Research department, Carol Saunders, Ph.D., will advise the **Evaluation Team**. She will be joined by the zoo's Access Coordinator Ann Roth who will be the liaison between the project and the Zoo's Access Advisory Board, which includes representatives from the LaGrangeArea Department of Special Education, the Special Education Assistive Technology Center at Illinois State University, and the Center for Independent Living. Also participating are two staff from IIT, Norman Lederman, Ph.D., and Judith Sweeney Lederman, Ph.D. Norman Lederman is Professor and Chair of the IIT Department of Mathematics and Science Education. He is a recognized leader in developing innovative education practices to improve our nation's schools. Judith Sweeney Ledermanis a Senior Lecturer in the IIT Department of Mathematics and Science Education. Six Assistive Technology Evaluators from CPS also will participate on the Evaluation Team. These are Mario Cortesi, Cathy O'Flaherty, Valerie Lyons, Shannon Moffitt, Julie Monahan, and Andrew Schnepf.

PROJECT EVALUATION

Project evaluation by staff from IIT in conjunction with the Evaluation Team will involve both formative and summative components as well as quantitative and qualitative approaches. The evaluation plan will be multi-faceted in that both the process of re-purposing of materials as well as teachers' and students' reactions (attitudinal and cognitive) to materials will be foci of assessment. The evaluation plan will correspond to the first four of the five phases of the project activities; the fifth phase primarily involves dissemination and will not require an evaluation.

Phase I: This phase will involve the collection of data on the effectiveness of Game Boy Advance, Pocket PC, and wireless Web tablets with a pilot curriculum unit. Given that these three types of devices are probably preferable for different audiences, an approach assessing relative effectiveness will not be pursued. Initial data collected will be derived from a close monitoring of the re-purposing process. In particular, a qualitative approach will be used to assess the quality and dynamics of the interactions among Brookfield staff, CPS consultants, software consultants, and IIT consultants in the revision of curriculum materials. These data will provide formative information for the revision and fine-tuning of the collaborative process. Subsequent data collection will focus on both student and teacher reactions (derived from observations and interviews) to the technology and curriculum materials in terms of "user-friendliness." These data will indicate both problem areas as well as particularly productive aspects of the pilot curriculum and technologies. The focus will be on both attitudinal and cognitive outcomes.

Phase II*:* Monitoring of the revision of materials and technological aspects of the project will focus on the consistency of pilot materials revisions and recommendations from Phase I. Subsequent data collected from students will be analogous to student data collected earlier in an effort to assess whether changes have resulted in a product perceived more positively and more effective than the previous version.

Phase III*:* During this phase, instruments will be developed and administered that assess the effectiveness of the re-purposed curriculum in promoting the desired student content outcomes prescribed in the curriculum objectives. These assessments will be quantitative in nature and will be a combination of "traditional" assessment approaches and performance-based assessments. Approaches previously used with the pilot curriculum unit will be used to guide the re- purposing of an additional three curriculum units.

Phase IV*:* This phase will be the summative phase of the evaluation process. Quantitative instruments assessing students' attitudes and cognitive achievement of curriculum goals will be employed. In addition, teachers' reactions to the curriculum materials and technologies will be assessed. Random interviews with both teachers and students will also be used to gather further in-depth data on student and teacher reactions to materials. When appropriate, direct observations of both student and teacher behaviors during instruction and learning with materials will be completed. These observations will involve both

structured and open-ended foci depending on the particular curriculum unit and targeted activities. A comparison will be made between the curriculum units as they are currently used and the units that are re-purposed. Student learning-gains and teacher feedback will be assessed to gauge how effective the re-purposed units are in meeting learning goals. In addition, teachers will be encouraged to use the portfolio-based assessment available to track how students use the hand-held devices and make decisions to complete their assignments.

DISSEMINATION
Results from this project will be broadly disseminated, including research findings documenting the effectiveness of using wireless technology in an informal science learning setting, practical information on the accessibility and durability of different media and hardware approaches, and descriptions of the collaborative processes and the working philosophy. This information will be compiled and distributed in the form of a sourcebook, which will be available both on Brookfield Zoo's Web site and in a printed form.

In addition, project participants will give presentations at conferences serving the informal science learning community such as those hosted by the American Zoo and Aquarium Association (AZA), American Association of Museums (AAM), and Association of Science and Technology Centers (ASTC), as well as conferences among the assistive technology community such as Closing the Gap (closingthegap.com), which focuses on computer technology in special education and rehabilitation, and the Conference on Technology and Persons with Disabilities sponsored annually by the Center on Disabilities at California State University, Northridge.

When possible, presentation teams from the zoo and CPS will co-present the results. In addition, Brookfield Zoo, with funding from the AZA, is offering a full-day training workshop in fall 2002 for 24 other zoos and aquariums. This session will help these institutions learn how they could adapt one of Brookfield Zoo's computer-based teaching tools for use at their facilities. Similar workshops could be offered at the conclusion of the Every Student is a Scientist project.

SUSTAINABILITY
The results of this project will be incorporated broadly at both CPS and Brookfield Zoo. At CPS, the re-purposed curricula will be used as models for inquiry-based units that can foster inclusion in the classroom and learning gains for all. Future teacher in-services will focus on helping both general education and special education teachers to use these kinds of resources.

Once the wireless hardware and authoring software is in place at Brookfield Zoo and the staff have developed expertise in using this new technology, the majors barriers to using this technology with other zoo curricula will have been eliminated. As a result, all future curricula will be designed to use this technology when appropriate. The zoo currently budgets every year to update older curricula with newer media/technology (for example switching from slides to videos), and some of these funds will be used annually for re-purposing. The zoo will work with CPS to prioritize curricula for re-purposing.
If, as we suspect, the use of this technology results in significant learning gains for all students involved in the project, the zoo will work towards increasing the availability of the hand-held devices to any visiting class that wants to use them.

The zoo will seek additional funding to purchase and maintain additional devices as needed and to expand the coverage of the wireless network that supports them.

Despite conferences such as Museums and the Web, there are a limited number of models for collaborative development and implementation of museum projects using new technologies (web sites, video conferencing, computer interactives in exhibits). The comprehensive evaluation approach proposed for Every Student is a Scientist will produce valuable results that will inform future efforts of museums worldwide.

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